DOCUMENT RESUME

ED 077 450 HE 004 278

TITLE	Manpower and Financial Resources Allocated to Academic Science and Engineering Activities, 1965-71.
INSTITUTION	National Science Foundation, Washington, D.C. Div. of Science Resources Studies.
REPORT NO	NSF-72-302
PUB DATE	20 Mar 72
NOTE	4p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	Colleges; Educational Finance; Educational Programs; *Engineering Education; *Higher Education; *Manpower Utilization; Research; *Resource Allocations; *Science Education; Universities

ABSTRACT

This report summarizes the results of the National Science Foundation's biennial survey of manpower and financial resources for scientific engineering activities at institutions of higher education, 1971. The survey was conducted by mail questionnaires sent to 2,198 universities and colleges that maintained science and engineering programs, and was comparable in scope and coverage to previous NSF biennial surveys conducted since 1965. Usable questionnaires were received from about three-fourths of these institutions. Figures shown in this report, however, represent universe totals, since they include estimates for all nonrespondents. For the purposes of this report "universities and colleges" include all organizational components of such institutions except 35 university-administered federally funded research and development centers, for which a summary is presented at the end of this report. (Author/MJM)

FILMED FROM BEST AVAILABLE COPY

ED 077450

nsf SCIENCE RESOURCES STUDIES HIGHLIGHTS

NATIONAL SCIENCE FOUNDATION • WASHINGTON, D.C. 20550 • MARCH 20, 1972 • NSF 72-302

Manpower and Financial Resources Allocated to Academic Science and Engineering Activities, 1965-71

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

This report summarizes the results of the National Science Foundation's biennial survey of manpower and financial resources for scientific and engineering activities at institutions of higher education, 1971. The survey was conducted by mail questionnaires sent to 2,198 universities and colleges that maintained science and engineering programs, and was comparable in scope and coverage to previous NSF biennial surveys conducted since 1965. Usable questionnaires were received from about three-fourths of these institutions. Figures shown in this report, however, represent universe totals, since they include estimates for all nonrespondents. For the purposes of this report, "universities and colleges" include all organizational components of such institutions except 35 university-administered Federally Funded Research and Development Centers (FFRDC's), for which a summary is presented at the end of this report.

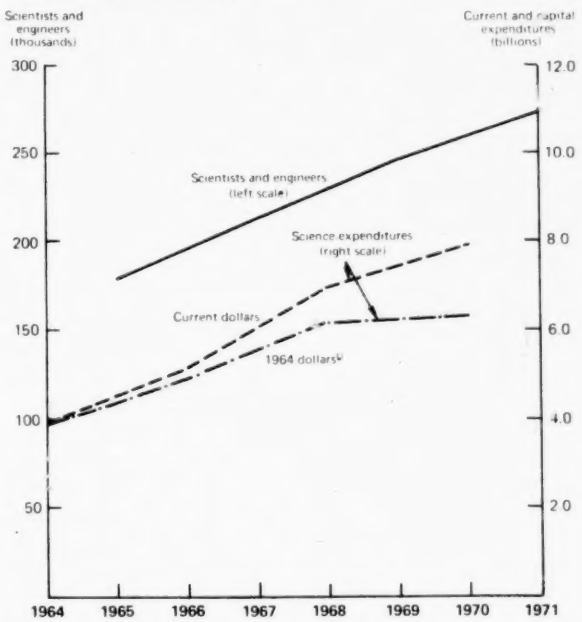
1965-71 Trends

- The 273,800 full- and part-time scientists and engineers employed in universities and colleges in January 1971 represented a 6-percent per year increase over the 246,200 total for January 1969, compared with an 8-percent annual rate of increase that prevailed during 1965-69 (chart and table 1).

- The difference in annual growth rates between the two periods was more pronounced in financial terms. The $7.9 billion total for current and capital expenditures for science and engineering in 1970 represented an increase of 6 percent per year over the comparable figure for 1968, compared with a 15-percent annual rate of increase in such expenditures during 1964-68 (table 2). In terms of constant dollars based on the U.S. Department of Commerce's gross national product (GNP) implicit price deflator, the 1968-70 increase averaged only 1 percent per year, while the 1964-68 rate of growth averaged 12 percent per year.[1]

- The 6-percent annual rate of growth in expenditures for scientific and engineering activities in current dollars during 1968-70 was considerably lower than the 16-percent annual rate of increase in current and capital

Trends in the employment of scientists and engineers, 1965-71, and in expenditures for scientific activities in universities and colleges, 1964-70[a]



a. Employment figures relate to January of the designated year, expenditures data relate to academic years, e.g., 1970 relates to academic year 1969-1970.

b. Based on the GNP implicit price deflator.

Source: National Science Foundation

[1] The U.S. Department of Commerce's GNP implicit price deflator increased at annual rates of 3.0 percent during 1964-68 and 5.2 percent during 1968-70. The foregoing rates approximate the annual rates of price change in *direct R&D expenditures* only (4.0 percent for 1964-68 and 5.3 percent for 1968-70), which were published in National Science Foundation, *Science Resources Studies Highlights*, "Estimated Academic R&D Price Trends 50 Percent Higher Over Decade 1961-71" (NSF 71-32) (Washington, D.C. 20550), Nov. 1, 1971.

HE 004 378

expenditures for "nonscientific" activities in universities and colleges that prevailed during the 2-year period.[2]

- Current R&D expenditures, both Federal and non-Federal, totaled $2.9 billion in 1970, or 36 percent of total expenditures for scientific activities. The 5-percent per year rate of increase (a slight decrease in terms of 1964 dollars) in R&D expenditures during 1968-70 was considerably below the 13-percent (10 percent in terms of 1964 dollars) annual growth rate during 1964-68. The main factor responsible for the slackened rate of growth was Federal R&D financing, which increased only 3 percent per year during 1968-70, compared with 14 percent per year during 1964-68.[3]

[2]Estimates of total current and capital expenditures of universities and colleges were based on data in U.S. Office of Education, *Projections of Educational Statistics to 1979-80* (OE-10030-70)(Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office, 1970), pp.91-92. The Office of Education's figures for all institutions of higher education were adjusted to exclude expenditures of university-administered FFRDC's, which are presented separately in this report.

Scientists and Engineers

U.S. universities and colleges employed 273,800 full- and part-time scientists and engineers in January 1971 (table 1). Comprising this staff was a high proportion of the Nation's most qualified personnel, including well over one-half of the Nation's science and engineering Ph.D.'s. The staff also included 47,000 scientists with

[3]These rates vary slightly from those published in the National Science Foundation's annual report to the Federal Council for Science and Technology's Committee on Academic Science and Engineering, which shows a compound annual rate of 10 percent from 1964 to 1968, but only 1 percent between 1968 and 1970. The differences are largely a consequence of the fact that figures reported to CASE are based on obligations reported by Federal agencies, whereas totals presented in this report are based on expenditures data reported by the universities. In addition, the time lag between obligations and expenditures usually ranges between 1 and 3 years. Thus the expenditures reported for academic year 1970 were largely financed out of 1968 and 1969 obligations, and to a lesser extent from 1967 and 1970 obligations. See National Science Foundation, *Federal Support to Universities, Colleges, and Selected Nonprofit Institutions, Fiscal Year 1969*, A Report to the President and Congress (NSF 70-27) (Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office, 1970), p.4.

Table 1.–*Selected characteristics of scientists and engineers employed in universities and colleges, 1965-71*

[Numbers in thousands]

Item	1965	1967	1969	1971	Compound annual rate of change (percent) 1965-69	1969-71
Number of full-time and part-time scientists and engineers	178.9	212.9	246.2	273.8	8.3	5.5
Employment status:						
Full time	142.7	170.6	199.6	223.1	8.8	5.7
Part time	36.2	42.3	46.6	50.7	6.5	4.3
Educational attainment:						
Ph.D.	[a]	88.9	107.3	123.5	[b]9.9	7.3
Master's	[a]	63.2	72.8	78.9	[b]6.8	4.1
M.D., D.D.S., etc.	[a]	38.7	41.7	46.5	[b]2.0	5.6
Bachelor's or the equivalent	[a]	22.1	24.3	24.8	[b] .1	1.0
Field of employment:						
Life scientists	75.8	87.3	97.2	110.3	6.4	6.5
Social scientists	32.9	39.8	52.6	59.1	12.5	6.0
Physical scientists	25.5	31.4	33.7	35.9	7.2	3.2
Engineers	21.7	25.3	25.4	27.1	4.0	3.3
Mathematicians	13.7	17.8	22.5	24.5	13.2	4.3
Psychologists	9.4	11.4	14.8	16.8	11.9	6.5
Type of institution in which employed:						
Doctorate granting	118.2	142.8	159.1	176.4	7.7	5.3
Nonscience degree granting	17.2	22.4	29.2	36.8	14.2	12.3
Master's granting	21.1	24.7	33.2	33.9	12.0	1.1
Bachelor's granting	22.4	23.0	24.8	26.7	2.6	3.8
FTE scientists and engineers	156.3	186.4	217.3	242.7	8.6	5.7
Teaching	99.6	119.0	145.0	170.8	9.8	8.5
Research and development	40.4	47.5	50.4	49.8	5.7	-.6
Other activities	16.3	19.8	21.9	22.1	7.7	.5

[a]Not available.

[b]Annual rates of change in the educational attainment of scientists and engineers relate to 1967-69, since data for 1965 were not collected.

M.D.'s or other health professional doctorates as their highest earned degree, most of whom were working in medical or other health professional schools. Although universities and colleges employ large numbers of the most highly qualified scientists and engineers in terms of academic achievement, their professional staff in the sciences and engineering comprises only about one-sixth of the estimated national total.[4] The decline in recent years in the rate of increase in the employment of scientists and engineers reflected principally the reduced rate of growth in R&D activities.

From 1969 to 1971 the full-time equivalents (FTE) of scientists and engineers in research and development declined; in contrast, the annual rates of increase of FTE's in teaching were rather stable throughout the 6-year period. Figures shown in this report on employment in years prior to 1971 represent slight downward revisions from those given in earlier reports. These revisions reflect principally the exclusion of M.D.'s and other health-professional personnel primarily engaged in patient care and other clinical activities in university-operated hospitals from scientific employment classifications.

Among the other developments have been sizable increases in the employment of scientists and engineers in institutions not granting science degrees, principally junior colleges and other institutions with less than 4-year programs. The employment of scientists and engineers increased at an annual rate of 12 percent at such institutions during 1969-71, which was only slightly below the 14-percent annual rate during 1965-69.

[4] The employment figure for scientists and engineers does not include 94,300 graduate students who were compensated for their part-time services as scientists and engineers, but does include 50,700 part-time scientists and engineers whose principal employment is in industry or government. The estimated 1.6 to 1.7 million scientists and engineers in January 1971 is based on unpublished figures of the National Science Foundation and related information.

Table 2.–*Characteristics of current and capital expenditures for research, development, and instruction in the sciences and engineering in universities and colleges, selected years, 1964-70*[a]

[Dollars in millions]

Item	1964	1966	1968	1970	Compound annual rate of change (percent) 1964-68	1968-70
Total	$3,959.2	$5,129.0	$6,957.3	$7,872.5	15.1	6.4
(In 1964 dollars)	($3,959.2)	($4,898.8)	($6,189.7)	($6,325.4)	(11.8)	(1.1)
Type of expenditures:						
Current R&D expenditures[b]	1,594.9	2,084.7	2,598.7	2,856.4	13.0	4.9
Current expenditures for instruction[c]	1,834.8	2,377.3	3,287.8	4,064.1	15.7	11.2
Capital expenditures	529.5	667.0	1,070.7	951.9	19.2	–5.7
Type of institution:[d]						
Doctorate granting	3,136.2	4,084.2	5,452.9	6,175.0	14.8	6.4
Master's granting	361.6	448.2	685.0	689.4	17.3	.3
Bachelor's granting	284.1	337.2	429.5	463.7	10.8	4.0
Nonscience degree granting	177.3	259.3	390.9	544.3	21.9	18.0
Type of control:						
Public institutions	2,403.5	3,172.4	4,292.5	5,063.5	15.6	8.6
Private institutions	1,555.7	1,956.6	2,664.8	2,808.9	14.4	2.7
Field of science:[e]						
Life sciences	1,702.1	2,088.2	2,683.1	3,016.5	12.0	6.0
Physical and environmental sciences	736.1	992.2	1,314.7	1,346.4	15.6	1.2
Social sciences	492.6	681.9	1,042.7	1,274.1	20.6	10.5
Engineering	522.2	712.8	866.9	991.9	13.5	7.0
Mathematics	206.8	282.8	418.9	507.3	19.3	10.0
Psychology	149.5	190.8	290.5	329.7	18.1	6.5
Other sciences, n.e.c.	109.3	97.2	245.1	262.4	22.4	3.5

[a] Includes indirect costs associated with current direct expenditures for research, development, and instruction.

[b] Includes estimated expenditures for departmental research and other R&D activities for which most universities and colleges do not maintain separate records.

[c] Excludes departmental research expenditures, which are included in this table with current R&D expenditures.

[d] Based on highest earned degree granted in the sciences or engineering.

[e] Excludes current expenditures for development amounting to $37.6 million in 1964, $80.3 million in 1966, $95.4 million in 1968, and $144.2 million in 1970 for which a field-of-science distribution was not requested.

Financing of Scientific Activities

Scientific and engineering expenditures of universities and colleges sponsored by all sources reached $7.9 billion during 1970. This amounted to $6.3 billion in terms of 1964 dollars, an increase of only 1 percent per year over the comparable figure for 1968. Such expenditures increased at a somewhat lower annual rate during 1968-70 than that which prevailed during 1964-68 (table 2). The 1968-70 period was characterized by wide shifts among the principal type of scientific expenditures for which separate data are available. For example, current R&D expenditures increased at a compound annual rate of 13 percent between 1964 and 1968, but the rate dropped to 5 percent between 1968 and 1970. The change in capital expenditures was even more dramatic: an increase of 19 percent per year between 1964 and 1968 gave way to a decrease of 6 percent per year between 1968 and 1970. Only for current expenditures for instruction was the rate of increase comparatively steady: 16 percent per year between 1964 and 1968 compared with 11 percent per year between 1968 and 1970.

Current and capital expenditures for the life sciences, accounting for 39 percent of the total, far exceeded the total for any of the other fields of science. On a rank-order basis, the distribution of current R&D expenditures coincided quite closely to that for all scientific expenditures. The principal exceptions were engineering ranking slightly ahead of the social sciences in R&D outlays, and the life sciences accounting for nearly one-half—48 percent—of total R&D expenditures. The relatively strong orientation of universities and colleges toward the life sciences is attributable largely to predominance of life science activities in medical schools and agricultural experiment stations. These two organizational components also account for a large share of life scientists as well as approximately one-fourth of the total expenditures for universities and colleges. Their sizable outlays for scientific activities contribute greatly to the relatively large shares of scientific manpower and funds accounted for by doctorate granting institutions of which they are a part.

The distribution among types of institutions remained fairly uniform throughout 1964-70, though the proportion of total expenditures at institutions which do not grant degrees in the sciences and engineering has increased steadily, from 4 percent in 1964 to 7 percent in 1970. These were the only institutions which showed a consistent growth rate over the 6-year period—22 percent per year from 1964 to 1968 and 18 percent annually between 1968 and 1970. Master's-granting institutions increased their expenditures at almost the same rate between 1964 and 1968, but during the latest interval increased less than 1 percent per year. Doctorate- and baccalaureate-level schools also increased their expenditures much more rapidly during the earlier period than in the later period.

Publicly controlled institutions were responsible for 64 percent of the scientific and engineering expenditures in 1970, including 60 percent of the current R&D expenditures, 66 percent of the current expenditures for instruction, and 70 percent of the capital expenditures. This is quite close to the distribution of scientific and engineering personnel, of whom 63 percent were employed in public institutions and 37 percent in those under private control. Similarly, figures published by the U.S. Office of Education show that public universities and colleges had 66 percent of the total graduate enrollment in 1970.[5]

The recent slowdown in rates of growth in the financing of scientific activities has been felt much more severely in private institutions than in those under public control. While between 1964 and 1968 the annual rates of growth were quite similar—16 percent per year in public institutions; 14 percent in private institutions—between 1968 and 1970 the rate of increase in the expenditures of private institutions fell to 3 percent per year, while those of public institutions fell only to 9 percent per year. In this connection, the annual rates of increase in graduate enrollment at private institutions dropped from 8 percent in 1964-68 to 4 percent in 1968-70, compared with rates of increase of 14 percent and 9 percent, respectively, in public institutions.[6]

University-administered FFRDC's

The 35 university-administered FFRDC's employed 11,300 scientists and engineers in January 1971. This represented a slight decline from the 11,500 total for 1969, and was only slightly higher than the 11,000 total for 1965. Nearly all of these personnel were employed full time, and virtually all were engaged in research and development. Current and capital expenditures totaled $900 million in 1970, including $737 million for current R&D expenditures and $163 million for capital outlays. The total expenditures increased at an annual rate of 3 percent between 1964 and 1970.

Further details relating to the manpower and financial resources utilized for scientific and engineering activities by universities and colleges and university-administered FFRDC's will be published in *Resources for Scientific Activities at Universities and Colleges*, to be published by the U.S. Government Printing Office later this year.

[5] U.S. Department of Health, Education, and Welfare, Office of Education, op. cit., p. 34.

[6] *Ibid.*